

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* MICHAEL WOJTOWICZ

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Appeal 2008-0316  
Application 09/833,372  
Technology Center 2800

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Decided: April 23, 2008

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Before EDWARD C. KIMLIN, THOMAS A. WALTZ, and  
KAREN M. HASTINGS, *Administrative Patent Judges*.

HASTINGS, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF CASE

Appellant appeals under 35 U.S.C. § 134 (2002) from a final rejection of claims 1-5 and 8-11, the only claims pending in the above-identified application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

The invention relates to a heterojunction bipolar transistor (HBT) and a method for making an HBT.

Claim 1 on appeal is illustrative:

1. A heterojunction bipolar transistor (HBT) comprising:  
a substrate;  
an n+ doped GaN subcollector layer;  
an n- doped GaN collector layer;  
a p+ doped base layer formed on top of said collector layer defining a base collector interface formed from alternating layers of AlGaN/GaN forming a superlattice;  
an n+ doped AlGaN emitter layer formed on top of said base layer defining an emitter base interface;  
a base contact formed on said base layer;  
a collector contact formed on said subcollector; and  
an emitter contact formed on said emitter.

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Ohta	4,620,206	Oct. 28, 1986
Razehgi	5,831,277	Nov. 3, 1998
Song	6,410,944	Jun. 25, 2002
Kodama (as translated) (hereinafter JP '934)	JP 4-251,934	Sept. 8, 1992
Kusano (as translated) <sup>1</sup> (hereinafter JP '164)	JP 63-248,164	Oct. 14, 1998

The Examiner rejected claims 1, 5, 8, and 9 under 35 U.S.C. 103(a) as unpatentable over Song in view of either of JP '934 or JP '164, and further

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<sup>1</sup> It appears that the translation of JP '164 referred to by the Examiner in the Answer was inadvertently not scanned into the electronic file for this application. Thus, the translation of JP '164 was recently scanned into the electronic file (April 9, 2007).

in view of Razeghi. To reject claims 2-4, 10, and 11, the Examiner adds Ohta.

### ISSUE

Has Appellant shown reversible error in the Examiner's determination that a person having ordinary skill in the art would have found it obvious to arrive at the claimed heterojunction bipolar transistor in view of the applied prior art?

### FINDINGS OF FACT

1. Appellant states that the invention relates to a heterojunction bipolar transistor (i.e., an HBT) with a base layer formed from alternating layers of gallium nitride (GaN) and aluminum gallium nitride (AlGaN) forming a graded superlattice structure (Spec. 2, ¶ [0008]). This structure increases the carrier velocity of electrons ejected from the emitter into the base, thus decreases the injected electron (i.e. carrier) transit time to improve the operating efficiency of the device (Spec., Abstract; Spec. 2, ¶ [0008]).
2. Song describes a GaN-based HBT with an AlGaN emitter, with a base layer of a p<sup>+</sup> GaN (Fig. 3). Song describes an HBT that comprises all the claimed elements recited in Appellant's claim 1, except Song does not describe that the base layer is a superlattice structure (i.e., the claimed p<sup>+</sup> doped AlGaN/GaN superlattice base layer) (Ans. 4; Song Fig. 3).

3. JP '934 describes a high speed InP-based HBT with a InGaAs emitter, with a base layer of InP/InGaAs superlattice structure (see, e.g., Fig 1B; p. 9, ¶ [0015]).
4. JP '164 describes a GaAs-based HBT with an AlGaAs emitter, with a base layer of GaAs/AlGaAs superlattice structure to improve the HBT's speed (see, e.g., English Abstract; p. 13, ll. 11-19).
5. JP '164 also describes that a superlattice base structure is advantageous for other material systems:

Regarding above described embodiment 1 and 2, the explanation was given in case the embodiment of this invention was used for Al GaAs/GaAs hetero junction system. If other hetero junction system is used, this invention will be effective. For instance, they are InGaAs/InAlAs, InP/InGaAsP, GaAs/AlGaAsP, InP/InGaAs, InAs/GaAsSb, cDTe/InSb, GnSb/ InAs and the like. In addition, we don't have to mention the fact that this invention is not limited [to the] above described embodiments.

JP '164, p. 13, ll. 2-9.

6. Razeghi describes a semiconductor III-V alloy superlattice structure of  $p^+$  AlGaN/GaN (see, e.g., col. 1, ll. 9-11; col. 2, ll. 1-8). Razeghi illustrates that it was known in the art how to form a superlattice of these materials.
7. Appellant's Specification states that the Razeghi patent "discloses a system for forming ...superlattice structures, hereby incorporated by reference." (Spec. 4, ¶ [0014]).

8. In the Argument section of the Appeal Brief and in the Reply Brief, Appellant does not rely on any secondary considerations of nonobviousness (*e.g.*, a persuasive showing of unexpected results relative to the closest prior art). (App. Br. 3-11; Reply Br. 1-3).

#### PRINCIPLES OF LAW

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains.’” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

*KSR* reaffirms the analytical framework set out in *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966), which mandates that an objective obviousness analysis includes: (1) determining the scope and content of the prior art; (2) ascertaining the differences between the prior art and the claims at issue; and (3) resolving the level of ordinary skill in the pertinent art. *KSR*, 127 S. Ct. at 1734. Secondary considerations such as commercial success, long felt but unsolved needs, or failure of others “‘might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.’” *Id.* (quoting *Graham*, 383 U.S. at 17-18.).

*KSR* states:

Often, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary

skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

*KSR*, 127 S. Ct. at 1740-41.

*KSR* further instructs “that when a patent claims a structure already known in the prior art that is altered by mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.” *KSR*, 127 S. Ct. at 1740.

In expressly rejecting the “obvious to try” argument in support of patentability, *KSR* states:

The same constricted analysis led the Court of Appeals to conclude, in error, that a patent claim cannot be proved obvious by merely showing that the combination of elements was “obvious to try.”...When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

*KSR*, 127 S. Ct. at 1742.

## ANALYSIS

### ***The § 103 Rejection of Claims 1, 5, 8 and 9***

We are in complete agreement with the Examiner and adopt his finding of facts and conclusions of obviousness as our own. We add the following primarily for emphasis.

We agree with the Examiner that the sole difference between Song and the HBT of claim 1 resides in the material of the base layer in the transistor. Specifically, the base layer of Song is p<sup>+</sup> doped GaN, whereas the base layer of claim 1 is a superlattice structure of p<sup>+</sup> doped AlGaN/GaN

(Fact 2). To resolve this difference, the Examiner thoroughly considered the collective teachings of the prior art references and determined that a person having ordinary skill in the art would have found it obvious to arrive at Appellants' claimed HBT. (Ans. 3-6).

Each of JP '934 and JP '164 teach that a superlattice base structure is advantageous to increase the speed of the HBT (Facts 3, 4). Given JP '934's and JP '164's disclosures with respect to HBTs that employ superlattice base layers (formed of the same materials as their respective collector and emitter layers), we share the Examiner's view that a person having ordinary skill in the art would have found it obvious to arrive at Appellant's claimed HBT in view of Song with either of these two references based on a reasonable expectation that a superlattice base structure (formed of the same materials as Song's collector and emitter base layers) would provide at least comparable, and likely superior, properties relative to the disclosed GaN base layer of Song.

Moreover, Razeghi describes a semiconductor III-V alloy superlattice structure made of AlGa<sub>N</sub>/Ga<sub>N</sub>, and is evidence that one of ordinary skill in the art knew how to make such a superlattice structure of these materials at the time Appellant's invention was made (Fact 6). Thus, this reference would have provided additional reasons why it would have been obvious to provide a superlattice base made of AlGa<sub>N</sub>/Ga<sub>N</sub>, instead of the Ga<sub>N</sub> base layer of Song, in view of the collective teachings of the applied prior art.

Appellant contends that "the Examiner has failed to provide a reference that shows that the teachings of one material system are applicable to [another] material system." (App. Br. 9). We disagree. As pointed out by the Examiner, JP' 164 does indeed teach that a superlattice base structure is

advantageous for other material systems (Fact 5). Thus, while Appellant urges that “the teaching of one patent with a material system are not transferrable to other material systems...” (App. Br. 9), this argument cannot be reconciled with the express teachings of JP’ 164 and the Examiner’s cogent explanations (Fact 5; Ans. 4-6, 13-14).

Further, we have not been directed to any evidence demonstrating that making and testing of a possible HBT that differs from Song only by changing the composition of the base layer to a superlattice structure would have required anything beyond the level of the ordinary skill. *KSR*, 127 S. Ct. at 1742 (“When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.”).

Appellant also argues that “...the Razeghi patent does not disclose the structure recited in the claims at issue.” (App. Br. 10; Reply Br. 3). We do not find this argument persuasive. Razeghi was not relied upon to teach *all* the structure of the claimed HBT, but only to illustrate that it was known in the art how to form a superlattice structure of  $p^+$  AlGaIn/GaN (Fact 6). Indeed, Appellant’s Specification incorporates the Razeghi patent by reference for disclosing a system for forming such superlattice structures (Fact 7).

We determine that in view of all the evidence discussed herein and in the Answer that the use of a superlattice structure for the base layer of Song appears to be no more than the mere substitution of one known base layer for another to achieve the predictable result of a higher efficiency HBT. *See*

*KSR*, 127 S. Ct. at 1739-40 (The question to be asked is “whether the improvement is more than the predictable use of prior art elements according to their established functions.”). The “improvement” herein appears to be no more than the predictable use of a known superlattice base layer (e.g., JP ‘934 or JP ‘164) using compatible materials (i.e., the superlattice of Razeghi) as that of a known HBT (Song), for the known desirable advantage of improved operating efficiency.

For the foregoing reasons and those stated in the Answer, we agree with the Examiner’s findings in support of obviousness for claims 1, 5, 8, and 9 based on the combined teachings of Song, JP ‘934 or JP ‘164, and Razeghi.

We have considered Appellant’s other arguments in the Appeal Brief and Rely Brief filed September 5, 2006, but do not find any of them persuasive.

***The § 103 Rejection of Claims 2-4, 10, and 11***

The Examiner adds Ohta to reject claims 2-4, 10, and 11 which require that the Al concentration of the AlGa<sub>N</sub> layers of the superlattice base be irregular or graded. According to the Examiner, Ohta teaches that either barrier-thickness-grading or barrier-composition-grading can be employed in a CHIRP superlattice to produce effective band-gap changes in superlattice structures (Ans. 7), which the Appellant does not dispute. Rather, the Appellant argues that the Ohta patent is specific to a particular material system and that “...the Examiner is attempting to apply broad teachings irrespective of the material system to which the teachings apply without providing any reference whatsoever that these teachings are applicable to

other material systems.” (App. Br. 12). We do not find this argument persuasive.

Contrary to Appellant’s contention, we find that the Ohta patent is not specific to any particular material system as evidenced, e.g., by the language of claim 1 which claims a superlattice semiconductor portion unlimited by any specified materials. Furthermore, the Supreme Court noted in *KSR* that although the teaching, suggestion, motivation test “captured a helpful insight,” an obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 127 S. Ct. at 1741. The knowledge that having an irregular or graded concentration in the layers of a superlattice HBT (i.e., barrier-composition-graded) was desirable, and was a known alternative to a thickness-graded superlattice HBT, would have been within the skill in the art, as evidenced by Ohta (see, e.g., claim 1 of Ohta). Furthermore, one of ordinary skill in the art is also a person of ordinary creativity, not an automaton. *KSR*, 127 S. Ct. at 1742.

Therefore, in view of the reference evidence, we determine that having an irregular or graded Al concentration in the AlGa<sub>N</sub> layers of the modified HBT of Song would have been within the ordinary level of skill in the art.

For the foregoing reasons and those stated in the Answer, we agree with the Examiner’s findings and conclusion in support of obviousness for claims 2-4, 10, and 11 based on the combined teachings of Song, JP ‘934 or JP ‘164, Razeghi and Ohta.

### CONCLUSION

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of the applied references, with Appellant's countervailing arguments for nonobviousness and conclude that the claimed invention encompassed by appealed claims 1-5 and 8-11 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

### DECISION

The Examiner's rejection of claims 1, 5, 8, and 9 as unpatentable over the combined teachings of Song, JP '934 or JP '164, and Razeghi is affirmed.

The Examiner's rejection of claims 2-4, 10, and 11 as unpatentable over the combined teachings of Song, JP '934 or JP '164, Razeghi and Ohta is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

PL Initial:  
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